T/N 327
Filing Code 6720

Date Issued January 1979

TECHNICAL NOTE

U.S. DEPARTMENT OF THE INTERIOR – BUREAU OF LAND MANAGEMENT

CONSTRUCTION AND MANAGEMENT OF STOCKPONDS FOR WATERFOWL

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FORWARD

In the last decade, the demand being placed on natural resources on public lands has increased many-fold. No longer can the public land manager afford the luxury of looking at a segment of land with a single purpose objective in mind. Although many segments will be assigned primary uses, other potential uses will need to be considered as spelled out in the Federal Land Policy and Management Act of 1976.

Stock ponds have been and in most cases will continue to be constructed primarily as a tool of grazing management. However, tremendous benefits for waterfowl have occurred, even to the point of creating new habitat over rather large areas, as a result of this range management technique. Information is available to show that minor modifications in the normal construction designs of stock ponds and in management after construction can further increase the benefits to waterfowl.

Current management of public lands requires the full input from a variety of disciplines, all of which place a heavy demand on the time of individuals in their own area of expertise. This publication is not intended to tell the range manager where stock water is needed, nor the engineer how to design the pond. Rather, it is intended to provide them with a quick reference to certain modifications and post-construction management techniques which will enhance a stock pond for wildlife, particularly waterfowl. Each will still perform and make decisions in his own discipline, but perhaps with a broader scope and to the advantage of a wider range of resources.

INTRODUCTION

The primary breeding range of North American waterfowl is in the northern half of the United States extending on into much of Canada. Near the center of this range is an area of traditionally high breeding waterfowl densities, frequently referred to as the prairie pothole region (Fig. 1). This area, including parts of Minnesota, North and South Dakota, Montana, Alberta, Saskatchewan and Manitoba, represents only 10 percent of the total waterfowl breeding habitat but may provide the breeding habitat for over 50 percent of the ducks. Of even greater importance is the fact that this area, in a wet year, may provide the breeding habitat for a majority of the mallards and pintails (Munroe 1963).

This highly productive area, much of which is identified by Bellrose (1976, p. 6) as mixed prairie, has been and is being subject to ever increasing, intensive agricultural practices. Accompanying this intensive use, drainage of natural wetlands has made drastic inroads into the waterfowl breeding habitat in this area. Although some drainage of wetlands was accomplished at earlier dates, during the period of 1945-1960, accelerated, often Federally-funded programs, reduced breeding marshes at an alarming rate. This period of wetland deterioration is well documented by Burwell and Sugden (1964).

In contrast to the reduction in waterfowl breeding habitat through drainage, some increase has occurred as a result of the construction of stock ponds. Although small artificial impoundments have been built throughout the United States, particularly since the drought-stricken 1930's, the ones of concern in this report are the stock ponds of the semi-arid grazing lands of the West.

One area of considerable potential is that segment defined by Bellrose (1976, p. 6) as short-grass prairie and referred to by Bue et al. (1964) as the northern plains. This area, which includes parts of the Canadian prairies, western Dakotas and eastern Montana and Wyoming, lies immediately south and west of the prairie pothole region (Fig. 1, area A). This area is, and will probably continue to be, largely utilized by the grazing industry. Large acreages are under public ownership and as such are under the Federal Land Policy and Management Act of 1976 which calls for a "broad management authority under the principles of multiple use and sustained yield". Thus, more intensive and refined grazing management in this area will likely result in an increase in water areas, rather than a decrease as in other areas subjected to more intensive cultivation. Material for this report was largely drawn from studies in the above defined area. Although present in lesser numbers than in the northern plains, several species of ducks breed in the more arid grazing lands to the west and south (Fig. 1, area B) where many of the recommendations found in this report are applicable.

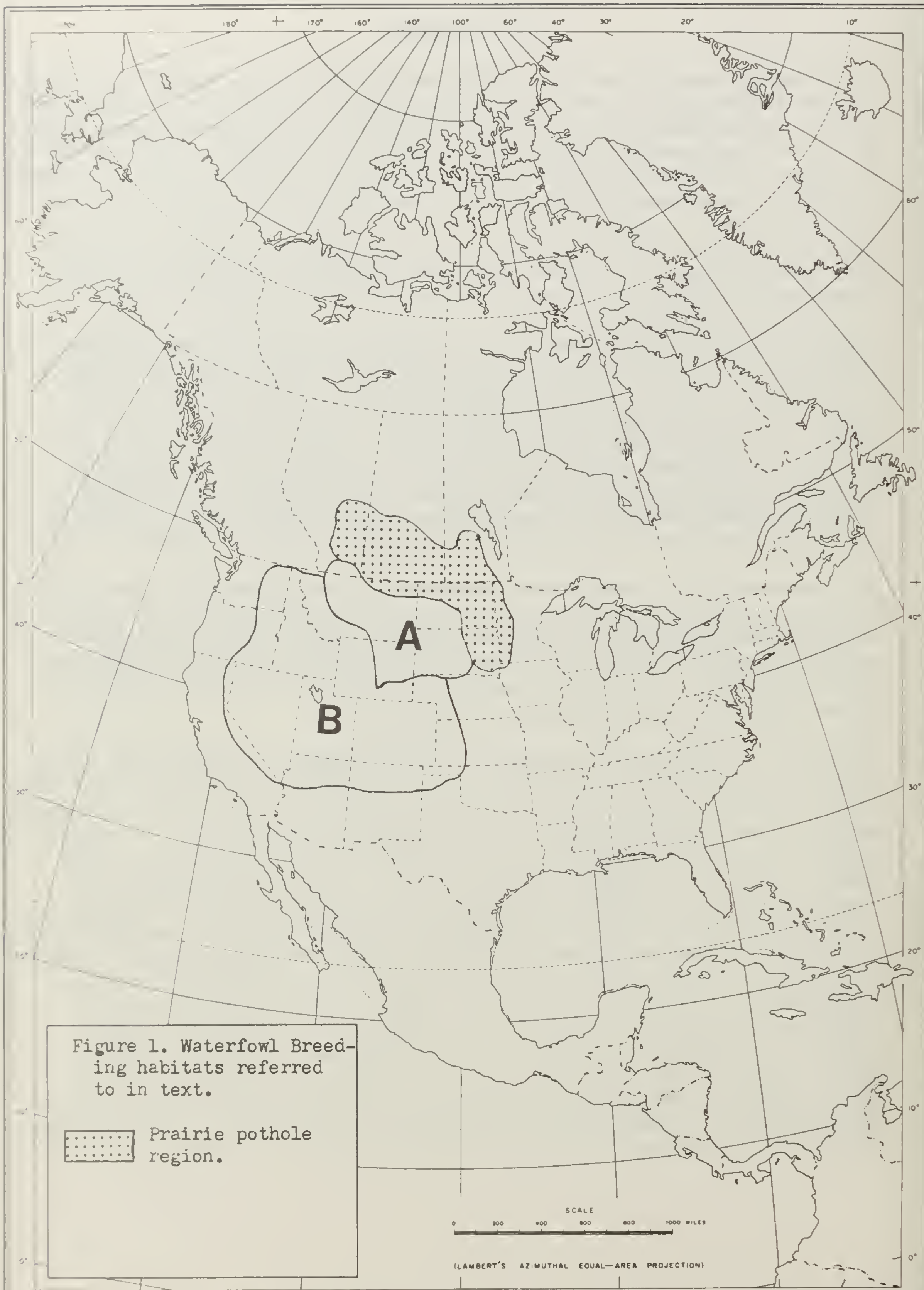


Figure 1. Waterfowl Breeding habitats referred to in text.

The number of stock ponds present in this short-grass prairie area would be difficult to ascertain. They have originated on a variety of land ownerships, both private and public, and likewise from a variety of funding sources. Bue, Uhlig and Smith (1964) estimated 220,000 stock ponds and 40,000 dugouts had been constructed in the two Dakotas, western Minnesota and Montana. By 1970, approximately 8,000 impoundments had been built in eastern Montana by a single agency, the Bureau of Land Management. At that time, this agency was building about 240 annually (Jones, 1970).

Several studies have been conducted in which waterfowl production and stock ponds have been discussed. Bue et al. (1952) in western South Dakota and Smith (1953) in eastern Montana pointed out the capabilities of this type of habitat for waterfowl production while Bue et al. (op cit) and Berg (1956) suggested the potential conflict between waterfowl nesting and grazing management around stock ponds. Comparative uses by waterfowl of different types of stock ponds have been discussed by Uhlig (1963) Gjersing (1971) and Rudquist (1975). Gjersing (1975) and Mundinger (1976) presented data on grazing management in relation to waterfowl production on stock ponds and McCarthy (1973) presented suggestions on stock pond construction which would enhance waterfowl production.

This report is a result of involvement and continued participation by the three authors in a series of studies conducted in north central Montana. The enthusiastic work of F. M. Gjersing (1971, 1975), J. J. McCarthy (1973), V. M. Rundquist (1973) and J. G. Mundinger (1975, 1976) has formed an integral part of the report and is gratefully acknowledged. The Bureau of Land Management, the Montana Department of Fish and Game and Montana State University have been involved in the implementation and continuation of the formal studies and the field activities carried out in the interim.

WILDLIFE USE OF STOCK PONDS

Waterfowl

Although waterfowl may make some use of stock-water ponds in the short-grass prairie areas during all ice-free seasons, the ponds make their greatest contribution to waterfowl during the spring and summer as breeding and brood rearing habitat. Prior to the construction of stock ponds, waterfowl use in this habitat type would have been confined to a scattering of shallow potholes and catch-basins along intermittent streams.

The species composition of waterfowl using stock ponds in the northern plains is quite varied and largely reflects those ducks which migrate through the area. Bue et al. (1952) on a grassland type in western South Dakota found the following six species of breeding ducks on 50 study ponds: Blue-winged Teal (Anas discors), Mallards (Anas platyrhynchos p.), Pintail (Anas acuta a.), Northern Shoveler (Anas clypeata), Gadwall (Anas strepera) and American Wigeon (Anas americana). Smith (1953) on 124 ponds in eastern Montana found the same species plus the Green-winged Teal (Anas crecca carolinensis) as breeding birds. Blue-winged Teal, Mallards and Pintails were the predominant breeders in the above studies making up 87 and 75 percent of the broods found by Bue et al. (1952) and Smith (1953), respectively, in 1951. Lokemoen (1973) in North Dakota, 1967-70, found broods of the same seven species as Smith, although the American Wigeon replaced the Pintail as one of the three leading species.

More recent studies have suggested a possible increase in the number of species breeding on stock ponds in the northern plains. Gjersing (1971) working on a study area with 33 stock ponds in north central Montana from 1968-70, found broods of seven species of ducks. He did not find Green-winged Teal broods but did observe those of Lesser Scaup (Aythya affinis). Mundinger (1975) working on the same area in 1973-74 found broods of ten species, adding the Redhead (Aythya americana) and Ruddy Duck (Oxyura jamaicensis rubida) to those previously listed. Rundquist (1973) in 1970-72 studied waterfowl production on two vegetation types, sagebrush-grassland and grassland, approximately 25 miles south-southeast of Gjersing's and Mundinger's study area. He found broods of 11 species of ducks, adding Canvasback (Aythya valisineria) to those already mentioned. All three studies recorded nesting Canada Geese (Branta canadensis) where suitable sites were available and observed breeding pairs of Cinnamon Teal (Anas cyanoptera septentrionalium). Trapping and banding of duck broods in this same northcentral Montana area has revealed some increase in use by certain species. While using the same trapping techniques in the same areas from 1972-76, the percent of Lesser Scaup in the total trapped birds has increased from 2 percent in 1972 to 11 and 9 percent in 1975 and 1976, respectively, (Eng and Greene, Unpubl. field data).

Thus, it appears that as the "new" habitat for ducks was created, the more adaptable puddle ducks (the Anas sp. such as the Mallard, Pintail, Blue-winged Teal, etc.) were the obvious invaders and the first to inhabit the stock ponds. As the ponds became more mature and better aquatic vegetation developed, some of the diving ducks (the Aythya sp., such as the Scaup, Redhead, etc.) began to make use of the areas. It also appears that this use may still be increasing and that full potential for breeding waterfowl has not been realized.

During the spring, breeding pairs of ducks tend to distribute themselves throughout the habitat (Evans and Black, 1956). Patterson (1976) reported that spacing mechanisms dispersed the breeding pairs to the available surface acreage of water, seemingly irregardless of pond fertility. In areas where a variety of water areas are available, pairs may make use of a series of ponds, progressing on to the more productive, in the sequence of breeding, nesting and brood rearing. In the northern plains where standing water is largely limited to artificial reservoirs, individual ponds at densities of 2 to 3 per square mile, are more likely to be used for all reproductive activities. Thus, the condition of the pond and the surrounding shoreline and upland vegetation become increasingly important.

Early nesting species, such as the Mallard and Pintail, will initiate nesting activities prior to new growth in the spring. Thus, they are very dependent for nesting cover upon residual vegetation carried over from the previous year. Some of the later nesting species like the Blue-winged Teal and the Lesser Scaup can rely on current seasons' vegetation growth for nesting cover, providing grazing pressures are not excessive. All species will frequently nest beneath clumps of vegetation which remain because they are unpalatable to livestock. However, Mundinger (1975) pointed out that waterfowl are prone to select a nest site based on the quality of the clump of vegetation in which the nest is located as well as the surrounding vegetation. Thus the overall grazing management and resulting condition of the vegetation becomes a critical factor for waterfowl nesting success.

Almost regardless of livestock stocking rates in short-grass prairie types, the cattle will concentrate around water sources, particularly during hot, dry seasons (July, August and September) resulting in removal of most of the shoreline vegetation. Islands will often partially offset this loss by maintaining a small segment of disturbed shoreline vegetation during most years. In addition to the presence of shoreline vegetation, islands are particularly attractive to certain species of ducks, as well as Canada Geese, and being free of mammalian predators, generally permit a much higher nesting success.

Successful brood rearing by ducks appears geared to an abundant food supply and good escape cover. Patterson (1976) showed that ponds with greater shoreline length and an abundance of food and escape cover were selected for brood rearing areas. Many of the food plants are those which grow beneath the water surface (submergents), some of which may grow in water up to 7 or 8 feet in depth. Submergents common to stock ponds in the northern plains are various pondweeds (Potomogeton spp.) and smartweeds (Polygonum spp.). Cover plants, those growing above the surface (emergents) generally prefer water depths of less than 3 feet. Common cover plants, some of which are also used for food, are sedges (Carex spp.), spike-sedge (Eleocharis macrostachya and E. acicularis), smartweeds and bulrush (Scirpus spp.). In general, those portions of the stock pond with depths of 2 feet or less, are more productive of vegetation which provides both food and cover for duck and goose broods.

Other Wildlife

Although the emphasis has been placed on benefits to waterfowl by stock pond construction, other species have benefited as well. In his studies in northcentral Montana, Rundquist (1973) recorded 113 bird species, 93 of which were recorded on or near his study ponds. Nineteen species of waterfowl were observed in the area; Whistling Swans (Cygnus columbianus), Canada Geese and 17 species of ducks, 11 of which were observed with broods. Other birds observed which were closely associated with an aquatic habitat were as follows: 3 species of grebes, White Pelicans (Pelicanus erythrorhynchos), Double-crested Cormorants (Phalacrocora auritus), 3 species of herons, 3 members of the rail family, 11 species of sandpipers, 1 phalarope, 3 species of gulls and 2 species of terns. Although many of the above species use the stock ponds in a transient manner, several use them as breeding habitat. While conducting banding studies on a series of stock ponds since 1970, Eng and Greene (unpub. field data) observed one Sora in 1973, a species which has been observed commonly as a breeding bird since that time.

Sharp-tailed Grouse (Pedioecetes phasianellus), Sage Grouse (Centrocercus urophasianus) and Hungarian Partridges (Perdix perdix) are frequently observed around stock ponds during July-September. Whether their presence is related to a free water requirement or the more lush vegetation is a point of conjecture; however, Patterson (1952, p. 68) made reference to reduced distribution of Sage Grouse on semi-arid lands as a result of lack of free water.

ARTIFICIAL PONDS AND RELATIVE VALUE TO WATERFOWL

Pit Reservoirs

Pit reservoirs or "dugouts" are steep-sided or rectangular excavations constructed to catch runoff or to intercept ground water (Fig. 2). The majority are smaller than 0.25 acres in size with depths varying from 6 to 12 feet. Those pits which are constructed to catch runoff are

Figure 2. An example of a pit reservoir.

Figure 3. An example of a pit-retention reservoir.

often built in, or on, the edge of large temporary potholes or in coulee bottoms. In areas of high water tables dugouts may be constructed to fill with ground water.

Due to the steepness of the banks, pits have little shallow water, and therefore, little emergent vegetation develops unless the pit is full and water flows into the surrounding vegetation. This only happens when pits are constructed in large temporary potholes and there is ample water (Mundinger 1975). At this time the piles of excavated dirt may become islands and attract nesting geese (Gjersing 1971).

The major function which pits serve to waterfowl is to provide areas for the establishment of breeding pair territories in the spring. However, temporary shallow potholes in which pits are often constructed, frequently serve this same purpose in addition to providing a good source of animal food for laying hens (Krapu 1974). The greater depth of the pit and resulting reduction in aquatic vegetation and invertebrates probably results in a net loss in overall waterfowl habitat. This is particularly true when water levels recede since little, if any, use of pits by waterfowl occurs when water levels fall two feet or more below the surface of the pit (Shearer 1960, Uhlig 1963, Gjersing 1971).

Brood use of pits is low when compared to other reservoir types. Of 362 broods observed by Gjersing (1975) in Phillips County, Montana, only three were observed on pits. Low brood observations on pits have also been reported by Lokemoen (1973), Mundinger (1975) and Rundquist (1973). As with pair use, higher water levels seem to result in greater brood use. Mundinger (1975) had duck brood use only on pits which were located in potholes which held water throughout the summer. This low use of pits by broods is also reflected in a lower survival rate. Stoudt (1971) found that broods forced to use dugouts about 0.1 acres in size survived less than one week, probably a reflection of the low security level of such small, vegetation free ponds.

Thus, it would appear that pits, when constructed in temporary potholes, provide little if any additional area for territorial pairs, are used very little by broods, and may reduce the amount of early spring shallow water habitat which is often at a premium in the geographical area of concern. Unless accompanied by a retention dam, pits in shallow basins should be a last resort in providing water to a grazing program.

Pit-Retention Reservoirs

Pit-retention reservoirs are a dam-dugout combination constructed in a natural drainage area (Fig. 3). The material excavated from the pit is used to build a dam immediately below the pit. Runoff water collects in the pit and during high water years floods into the surrounding area. This shallow flooded area usually supports a dense growth of emergent vegetation and provides an excellent feeding and brood-rearing area for waterfowl. During years of low rainfall and runoff when the flooded area dries up the pit provides a more permanent area for survival of broods nearing flight stage.

Pair use of pit-retention reservoirs is highest during years when water is sufficient to fill the pit and flood into the shallow margin around the pit. Mundinger (1975) found waterfowl pair densities were consistently greater on this reservoir type. As the shallow margins of the reservoir were reduced due to falling water levels, pair use declined. Lokemoen (1973) found that pair densities per surface acre did not differ significantly between any of the reservoir types, but pit-retention reservoirs, being smaller, held fewer pairs than retention type.

The degree of brood use on this type fluctuates with changing water conditions. Mundinger (1975) found that pit-retention reservoirs on his study area provided brood habitat only during the high water conditions which existed in 1974. No brood use was recorded during the low water conditions of 1973.

Retention Reservoirs

Retention reservoirs are constructed by building dams across natural waterways (Fig. 4). The size of the reservoir may vary from less than 1 acre to more than 200 acres depending upon the size of the dam and variations in watershed size and topography. In Montana and North Dakota most reservoirs average less than 10 acres in size (Rundquist 1973, Lokemoen 1973).

Most retention reservoirs have a considerable amount of gently sloping shoreline and shallow-water area. This shallow-water area, as with the other reservoir types, usually supports a dense growth of submergent and emergent vegetation which is used extensively by waterfowl.

Because of their larger size, and "general attractiveness" this reservoir type is the most valuable to waterfowl. Gjersing (1975) reported duck breeding pair use more than three times greater on retention type reservoirs as compared to pit type. Lokemoen (1973) found that retention reservoirs supported six times the number of pairs per dugout and three

Figure 4. Two examples of retention reservoirs in Montana.

times the number in diked dugouts (pit-retention). Brood use followed the same pattern. Gjersing (1975), Lokemoen (1973), Mundinger (1975) and Rundquist (1973) found brood use almost entirely confined to retention type ponds.

The importance of retention reservoirs becomes particularly acute during dry years. During this time many natural wetlands go dry and the water level on pits and pit-retention reservoirs becomes very low. Retention reservoirs, having a larger and more efficient watershed, provides a fairly stable water area for breeding, nesting and brood rearing. Bue et al. (1964) and Brewster et al. (1976) felt that the stability of these artificial impoundments would result in greater production over the years than many natural wetland areas.

Size of Stock Ponds

It can generally be stated that the larger reservoirs have greater waterfowl use. The small reservoirs, i.e., those under 1 acre in size serve primarily for the establishment of breeding pair territories. Lokemoen (1973) recorded the highest number of pairs per surface acre on this size. Evans and Black (1956) reported pair use per surface acre of natural wetlands varied inversely with size and that, although most of the pairs were on larger ponds, the smallest areas received the heaviest use per acre. McCarthy (1973) suggests a minimum size of 2 to 3 acres for nesting geese.

After hatching occurs, broods may move overland toward larger reservoirs which are characterized by stable water levels and emergent vegetation (Mundinger 1975, Berg 1956). This movement is due partially to the low security and survival offered by smaller ponds. Both Lokemoen (1973) and Stoudt (1971) found smaller brood sizes on ponds less than 1 acre in size, probably because of low security and increased predation. Many of the smaller ponds may not hold water throughout the brood season and thus force brood movement. Berg (1956) found that the 14 ponds without brood observations were 0.6 acre or less in size. All but two had 50 to 100 percent water loss from June through August.

Some authors have suggested an optimum size of reservoirs for brood use. Lokemoen (1973) recorded larger brood sizes and higher brood use per acre in reservoirs 1 to 5 acres in size. He felt that the larger ponds generally formed a harsher environment for broods by being deep, open and windswept. Edminster (1964) suggests a minimum size of 0.5 acre and a maximum size of 10 acres for maximum waterfowl use.

Depth and Shoreline Slope

There seems to be no relationship between maximum reservoir depth and waterfowl usage except that surface feeding ducks use mainly the shallower portions of the ponds, while diving ducks generally favor the deeper parts (Rundquist 1973). However, waterfowl do seem to respond in a positive manner to increased amounts of shallow-water area. Gjersing (1971) found pair use of dugouts was highest when water levels were high enough to flow into the area surrounding the pit and form a large body of shallow water. On retention reservoirs, brood use was least in ponds which had 0 to 10 percent of their surface area less than 2 feet in depth. Brood numbers per pond increased as the amount of area depth class increased and reached a maximum at 50 to 75 percent.

The degree of shoreline slope of a reservoir is directly related to the amount of shallow-water area in that reservoir (i.e. the steeper the shoreline slope, the less shallow-water area a reservoir contains, Gjersing 1971). McCarthy (1973) found that a high percentage of shoreline slope above 30° greatly reduced the aquatic feeding area of young goslings and may prevent access to terrestrial feeding sites. Gjersing (1971) felt that the difference in duck broods per pond in this relationship was due to the amount of feeding area (that area less than 2 feet in depth) and not the shoreline slope.

Thus, site selection of stock ponds to provide a water area with at least a portion of the surface in depths of 2 feet or less and portions of the shoreline with slope less than 30° would enhance the pond for both duck and goose brood rearing.

Age of Stock Ponds

The use of reservoirs by waterfowl generally increases with age. This is due to a variety of factors. The removal of topsoil and vegetation during construction of a reservoir results in reduced soil fertility for aquatic plant establishment and higher water turbidity. The higher turbidity of the water reduces light penetration and further reduces plankton and submergent plant growth (Rundquist 1973). As flooded terrestrial vegetation decays, removed topsoil is replaced, turbidity decreases, and the fertility of the pond gradually increases. Aquatic plants begin to appear and the reservoir matures into a more valuable area for waterfowl.

This maturation of the pond may require different lengths of time depending on the area and soil type. Gjersing (1971) found little pair use and no brood production on reservoirs less than 2 years old in Montana. Uhlig (1963) working in Minnesota found the majority of waterfowl use on ponds greater than 2 years old. Lokemoen (1973) found increased numbers of both pairs and broods on ponds greater than 5 years of age in North Dakota.

CONSTRUCTION OF STOCK PONDS FOR MAXIMUM WATERFOWL BENEFITS

Stock Pond Type and Location

Maximum benefits to waterfowl at minimum additional cost can be derived if certain design specifications are considered during the initial planning and construction phase of a stock pond. Of major importance is type of reservoir and location.

As has been pointed out earlier, retention dams are far superior to pits or dugouts and in most instances to pit-retention ponds. Frequently, a small retention dam can be built for approximately the same cost as a pit and the former is unquestionably superior for waterfowl use.

If several stock ponds are planned for a newly established grazing management unit, and the topography and pasture boundaries permit, a cluster of ponds is far more desireable than an equal number completely isolated from one another. Often, an individual pond will not contain all the requirements for breeding waterfowl. However, when located near other bodies of water, such ponds receive greater use than when they stand alone.

Once a drainage has been selected for a stock dam, the topography should be carefully examined for specific location. Recognizing that certain requirements for the dam and spillway must be met from an engineering standpoint, characteristics to look for from the waterfowl standpoint are as follows: (1) a minimum of 1.5 acres surface water at full capacity; (2) at least a portion of the reservoir with gentle slopes; (3) a minimum of 40 to 50 percent of the pond should have depths of 2 feet or less; and (4) sufficient depth present in the borrow area to reduce chances for total dry-up by late summer. When possible a pond at full capacity should include the flooding of a series of small side channels which often provides a desirable situation for island development at minimal cost and increases the shoreline surface-acre ratio. Hochbaum (1944, p. 79) demonstrated that a larger number of breeding pairs of ducks will be accommodated on a water area having a high amount of shoreline in relation to the surface acres of water. Thus, site selection for the reservoirs is one of the most critical factors in realizing waterfowl benefits from stock ponds. A theoretical situation illustrating points to look for is shown in Figure 5 where site A provides more shallow area and potential island sites than site B while requiring little more fill material for the dam.

Food Plants

Generally, aquatic plants will pioneer into newly created ponds and reservoirs, usually precluding the need for plantings. The length of time for natural establishment of aquatic vegetation will vary between areas and ponds. However, Bue et al. (1964) reported aquatics appearing in stock ponds the second year and becoming well established by the third to the fifth year. Use by waterfowl, particularly by broods (Patterson 1976) is closely correlated to the quality of the aquatic food sources and minimal use can be expected during the first few years.

In some instances, and on a case by case basis, it may be desirable to introduce native aquatic plants through transplanting in an effort to accelerate the sequence toward marsh vegetation. This may be especially true of isolated stock ponds where emergents such as bulrush have been extremely slow to establish. In some cases, the introduction of rootstocks could be accomplished in late summer when low water levels would expose suitable sites.

Island Construction

The value of islands to waterfowl is well documented in the literature (Hammond and Mann 1956, Atwater 1959, Keith 1961, Deubbert 1966, Drewien et al. 1970, Hook 1973, McCarthy 1973). Islands possess certain characteristics which make them beneficial to nesting waterfowl.

Small islands are frequently free of resident mammals and if located over 30 feet from shore and in 1½ feet of water, most mammalian nest predators are discouraged from investigating. Consequently, a high nesting security and nesting success results (Keith 1961).

Islands increase the shoreline surface-acre ratio which in turn increases the capacity for territorial occupancy by breeding pairs of waterfowl. Following the breeding season, this same additional shoreline provides secure loafing areas for broods plus added shallow areas for brood rearing.

Islands properly placed in stock ponds are usually isolated from cattle grazing at least during the growing season. As a result, they often

Figure 5. Potential sites for island construction in livestock reservoirs.

provide good to excellent nesting cover regardless of the grazing treatment being imposed on the surrounding shoreline.

Canada Geese and certain species of ducks are attracted to island habitat even beyond the presence of good nesting cover. In Phillips County, Montana, 44 islands were constructed in 23 stock ponds in March, 1973 prior to icebreak and spring runoff. Pond size varied from 2 to 12 surface acres and island size ranged from .01 to .15 surface acres. April aerial surveys were used to determine Canada Goose distribution and pair use of islands. In addition, 40 stock ponds in the same area with no islands were surveyed as control ponds. Follow-up ground surveys were made in May to determine nest site locations. Surveys were conducted for a four-year period beginning in April, 1973.

During the first year, 1 percent of the new islands were used by nesting geese. Islands were only a month old, supported little or no vegetative cover and many were being constructed while nest-site selection by Canada Geese was under way. Four years later, 57 percent of the islands were used by nesting geese. A strong preference was shown for the stock ponds with islands. Of the total number of ponds surveyed (23 with islands, 40 without), only 2 percent of the nesting geese observed were found on ponds without islands.

No use by nesting ducks was observed the first year, while in 1976, 3 percent of the islands were used by nesting Pintails and Mallards. This recorded duck use must be considered a very minimal figure since the ground surveys were made in early spring prior to nesting activities of many species of ducks (Blue-winged Teal, Gadwall, Northern Shoveller and Lesser Scaup) common to the area and which often show a preference for island or near water nest sites.

Site Selection and Type

Small islands should be incorporated into new reservoir design and construction. Certain characteristics exist in many stock dams for construction of at least one of two types of islands with a minimum of additional cost. Such sites can be easily identified and plotted in advance if topographical surveys are available of the reservoir sites, although even in the absence of topographical maps, the more obvious sites are often apparent.

In addition, many existing stock ponds have potential sites on which islands can often be built during low-water periods when heavy equipment is brought in for maintenance of the dam or spillway.

Push-up Islands. Natural high points of ground or the more gentle slopes in the upper end of the reservoir and/or side drainages provide good opportunities for construction of push-ups. In such instances, materials may be pushed up and compacted with a bulldozer or moved, dumped and sloped with a scraper. The use of scrapers often results in a more compact, properly sloped island which reduces wave erosion. At times during initial construction of a stock dam, materials excavated for the core of the dam or for creating greater depth in front of the dam can be moved a short distance and shaped into a small island almost as economically as "wasting" the excess material. Figure 6 illustrates a push-up island which was placed during initial construction of the pond.

Cut-off Islands. At many stock pond sites, one or more spits of land or peninsulas are present which provide an excellent opportunity for island construction. Although modifications may be made depending upon the topography, this type basically involves cutting off the tip of the peninsula and isolating it from the mainland.

Ideally, a long narrow tip (15-20 feet wide) of land which projects 1½ to 2 feet above the anticipated high water level can be isolated with a minimum of earth moving (Fig. 7). Depending upon distances involved, the material removed can be used in the dam fill or may be shaped into a push-up island in a nearby shallow area.

When the peninsula slopes up abruptly a short distance back from the tip, the materials removed in the cut can be moved to the more gently sloping tip, essentially extending it out into the pond. Cutting and pushing out frequently is more desirable than straight cutting since greater separation from the mainland is possible. The two methods described in building cut-off islands are illustrated in Figure 8.

Cut-off islands have certain distinct advantages over push-ups. They normally have a more natural slope which, along with their largely undisturbed soil condition, make them less subject to wave erosion. Secondly, established vegetation will be present on at least a portion of their surface providing nesting cover immediately and aiding somewhat in resisting wave erosion.

Size

Island size will obviously vary with each site. McCarthy (1971) found islands used by geese ranged from .03 to .13 surface acres in 3 to 15 acre stock ponds. Keith (1961) found that islands most used by nesting waterfowl were at least 50 feet in diameter (about .04 of an acre) and

Figure 6. Two examples of push-up islands that may be constructed during stock pond construction.

Figure 7. An example of a cut-off island in a stock pond in Montana.

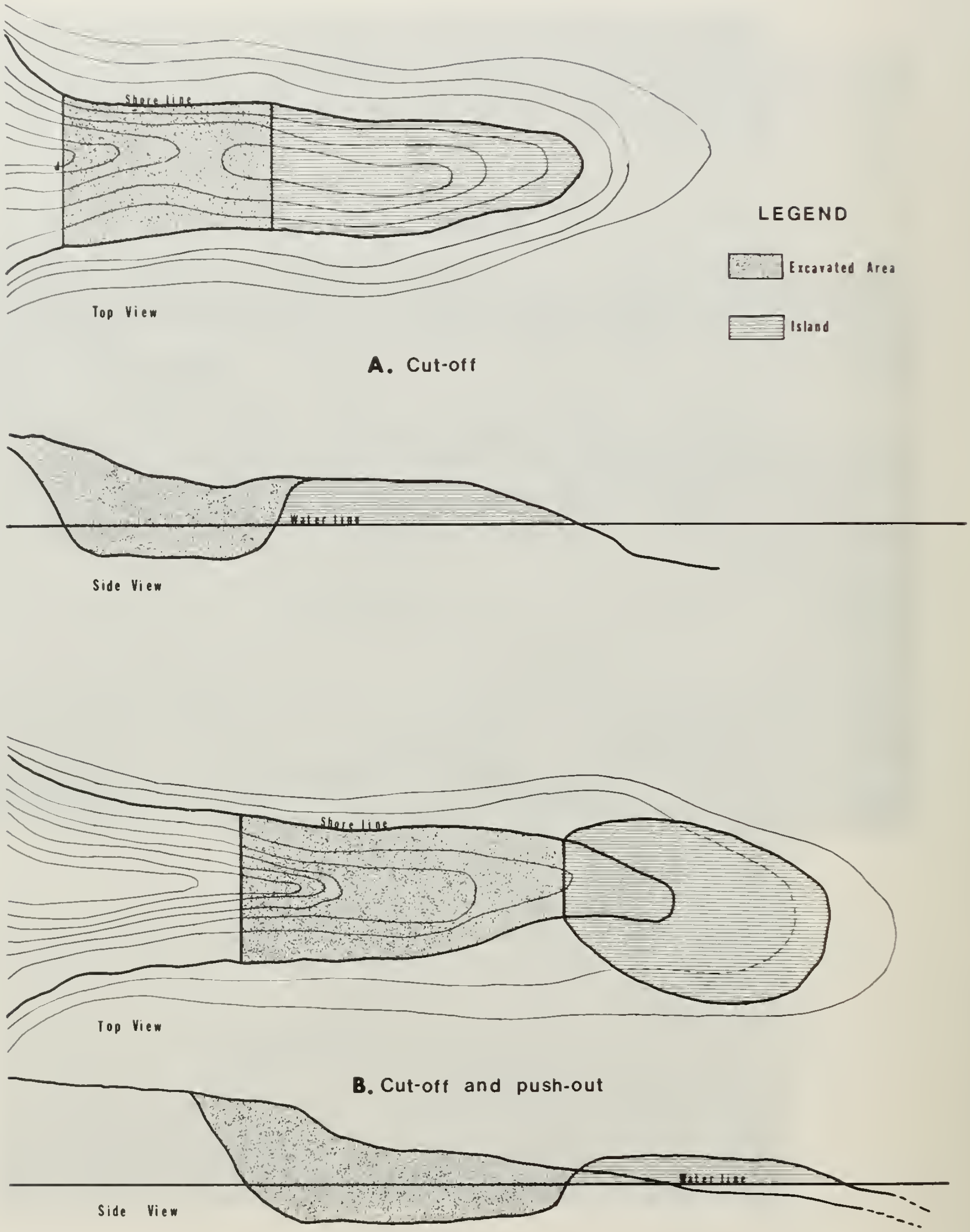


Figure 8. Two methods for creating cut-off islands.

$1\frac{1}{2}$ to 2 feet above the high water mark. He also suggested that by keeping the islands small, mammals were less apt to become permanent residents, gull nesting activity would be minimal, and livestock would be less apt to wade out to graze on them.

Slope

Island slope requirements on push-ups are quite critical to prevent bank cutting from wave action. A slope of about 5:1 from the berm or "breaching" area to the top of the island would prolong the life of the island. The 8 to 10 foot berm or beach at the high water level also aids considerably in preventing cut-banks on the island proper. A cross-section of a push-up island showing these features is presented in Figure 9. These guidelines can be modified somewhat depending upon the situation. If relatively course materials are available, or if the island is placed in a sheltered area in 1 to $1\frac{1}{2}$ feet of water the specifications for bank protection can be relaxed.

Location

In the interest of economy, the location of islands should be decided upon largely by the existence of quality sites. Nonetheless, greater flexibility in placement is available when island building is incorporated into initial reservoir construction in contrast to work done on existing stock ponds.

Push-ups provide the greatest flexibility in island placement. An attempt should be made to place the island at least 30 feet from the mainland. Prevailing winds should be considered and islands should be placed on the stock pond for minimal wind and resulting wave action. Water depths of $1\frac{1}{2}$ to 2 feet are adequate to deter most mammalian predators and islands placed in depths greater than this are subjected to greater wave action and will require moving more material.

In summary, islands enhance the attractiveness of stock ponds to waterfowl, and improve the nesting success to a measurable degree. Benefits of islands to nesting waterfowl are sufficiently great that no stock pond should be constructed without the island potential being thoroughly investigated. However, the location of some ponds (i.e. small size, steep banks, excessive depth, straight shorelines, etc.) prohibits island construction or makes their cost override the advantages. Generally, those ponds which by themselves would be most attractive to waterfowl (1.5 acres or greater in size, portions in 1 to 2 feet in depth and irregular shoreline) are also those which lend themselves to more economical construction of islands. Figure 5 showed a theoretical

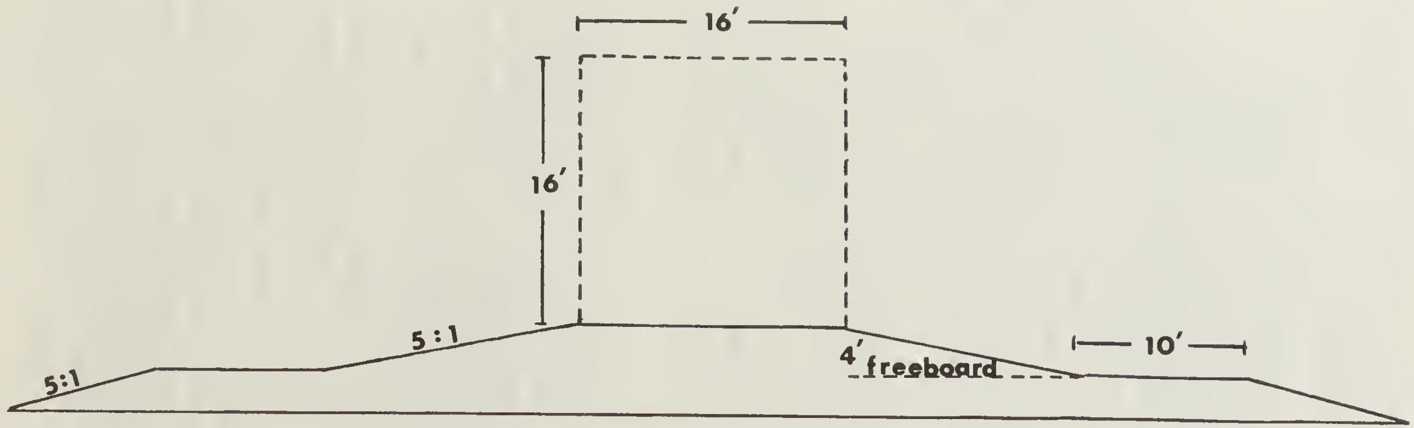


Figure 9. Cross-section of a push-up island showing recommended size and slopes.

comparison of two stock pond sites on a single drainage showing the comparative potential for island development.

GRAZING MANAGEMENT AND WATERFOWL

Continuous Grazing

Continuous grazing permits livestock to graze an area throughout a grazing season, year after year. The season of use may be seasonal or year long depending upon climate. Restriction is normally made on the number of livestock allowed to use a given area.

The main disadvantage of this system is that it usually concentrates cattle in the same places year after year. This gradually results in undesirable successional changes in range forage (Stoddart, Smith and Box 1975). It has been estimated that this type of grazing and long seasons of use have reduced grazing capacity for livestock on many western ranges by half or more (Hormay 1970).

Waterfowl breeding pair use on continuous grazed areas is directly related to the intensity of grazing. Bue et al. (1952) found that the quality of the shoreline cover decreased as grazing intensity increased and this resulted in reduced use by breeding pairs. The greatest number of breeding pairs is associated with grass covered shorelines and, if grazing increases to such intensity that only mud shorelines occur, use by breeding pairs declines (Bue et al. 1952, Smith 1953, Berg 1956).

As would be expected, nesting density and success are also directly related to grazing intensity. Grazing reduces the density, height and species composition of nesting vegetation. As this density and height is reduced, nesting density and success declines. Bue et al. (1952) found no nests in areas grazed more than 30 cattle days per acre-year in western South Dakota. The majority of nests were found in areas grazed no more than 14.9 cattle days per acre-year. Kirsch (1969) found nest density and hatching success about twice as high on ungrazed as on grazed plots. Glover (1956) found 24.4 percent success on idle land and lightly grazed areas in Iowa, compared with only 10.5 percent success on heavily and moderately grazed areas.

Brood production follows the same pattern. Bue et al. (1952) recorded ponds with grass type shorelines were utilized by broods three to four times as much as those ponds with mud shorelines. Smith (1953) reported reservoirs with sparse vegetation and subjected to heavy grazing constituted 31 percent of all reservoirs under consideration but produced only 18.9 percent of 196 broods. This reduction in brood use on heavily grazed areas is apparently due to reduced amounts of brood cover and food on these areas. Lokemoen (1973) found the optimum in cover was flooded brush or emergent vegetation sufficient to allow broods concealment while remaining on the water. Heavy grazing of shorelines increases the turbidity of the water which lowers the amount of aquatic plant and animal food (Bue et al. 1964).

Waterfowl production may be increased on these areas by reducing grazing intensity where possible, or at least staying within recommended stocking rates where overgrazing occurs.

Rest-Rotation Grazing

Rest-rotation grazing (Hormay and Talbot 1961) is a system designed to improve range condition, primarily through periodic relief from grazing. A specific allotment is divided into pastures and each pasture is systematically grazed and rested according to a prescribed formula.

In Montana, research has shown definite relationships between waterfowl breeding pair numbers and the rest-rotation grazing formula. Gjersing (1975) reported greatest increases in pair populations occurred on those pastures which were rested the previous year. These increases were attributed to increased amounts of residual cover resulting from the rest treatment of the previous year. Conversely, decreases in pair numbers occurred in pastures which were grazed during late summer and fall of the previous year and thus had little residual cover the following spring. Keith (1961) also noted that since some species of waterfowl begin to nest before new growth provides aquatic cover, the presence of residual cover from the previous year is extremely important.

In addition to the rest treatment, some regrowth of vegetation resulting in residual cover the following spring may be expected after the end of the earliest treatment if cattle are moved out of pastures at this time. Fall regrowth, which is often characteristic of much of the northern plains, would vary from area to area depending upon the precipitation patterns, i.e. the season and amount. In 14 of 16 instances, complete rest or grazing only during spring and early summer, resulted in an increase of broods the following spring. In 10 of 16 instances grazing during late summer and fall resulted in a decrease of broods the following spring. Mundinger (1976) reported similar results.

Negative responses by waterfowl were observed when grazing was concurrent with the waterfowl breeding and nesting season (Mundinger 1976). A reduction in pair use of pastures subjected to spring and early summer grazing was evident. A corresponding increase of breeding pairs occurred in pastures not grazed during this period. Kirsch (1969) found that breeding pairs were disturbed by cattle concentrations and a reduction in breeding pair numbers occurred when cattle were turned into cattle-free plots.

The early grazing treatments may physically affect nesting success. Both Gjersing (1975) and Mundinger (1975) recorded nests lost by cattle trampling. This occurred mainly on nests located close to water, where cattle tend to concentrate. A grazing system which would delay grazing on pastures with greatest amount of residual cover, until after the peak of hatching, may further increase the nesting success.

When compared to continuously grazed areas, rest-rotation was determined to be decidedly better for waterfowl production. Brood production more than doubled in a three-year period from 1968-70 on this type of system while production on control areas remained fairly stable (Gjersing 1975). Further increases on this same area were recorded by Mundinger (1976).

Grazing formulas, which would provide maximum waterfowl benefits on three, four and five-pasture systems, are presented in Figure 10. A portion of the recommendation is based on data from geographical areas in which moisture patterns and growing seasons encourage fall regrowth of vegetation.

The key factor for waterfowl benefits in all three formulas is the presence in the spring of residual vegetation in a maximum number of pastures, since breeding pairs of ducks are attracted to and reproductive success is higher in ponds within such pastures (Gjersing 1971, Mundinger 1976). When the ducks returned in the spring, the pasture most attractive to breeding pairs (assuming stock pond numbers and types are somewhat equal between pastures) would be the previous years' rest pasture, generally followed by those which were grazed only during the spring and early summer. These conditions are illustrated in Figure 11 which shows comparative amounts of residual vegetation present along the shoreline of a stock pond in each pasture of a five-pasture unit. The photos were taken on April 25, 1975 just prior to spring turn-in of livestock. In 1974, pastures 1 and 2 had been grazed from June 1 through October 31, pasture 3 from May 1 through July 15 and pasture 5 from August 15 through October 31. Pasture 4 had been rested throughout the summer.

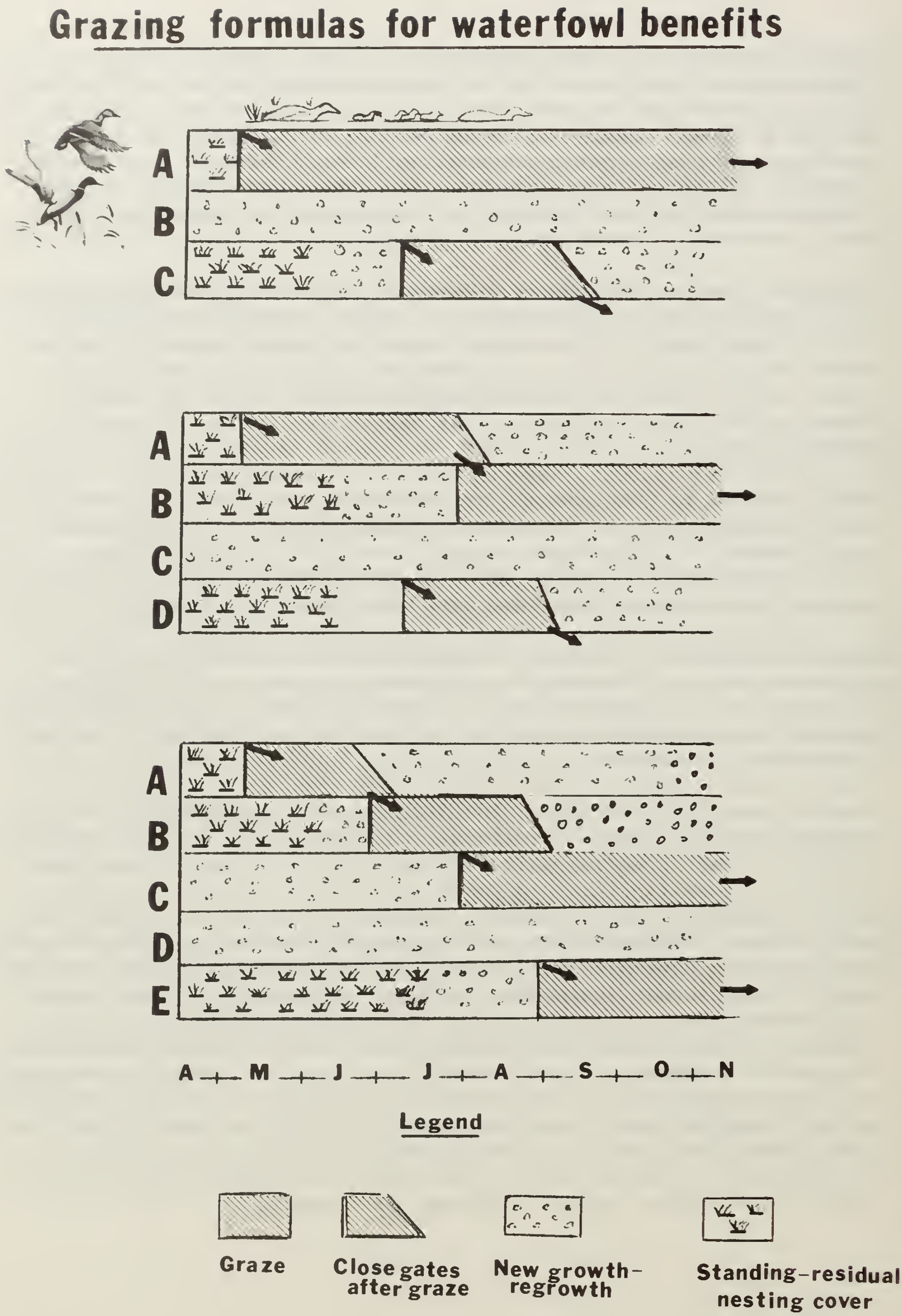


Figure 10. Rest rotation grazing formulas that will provide maximum waterfowl benefits.

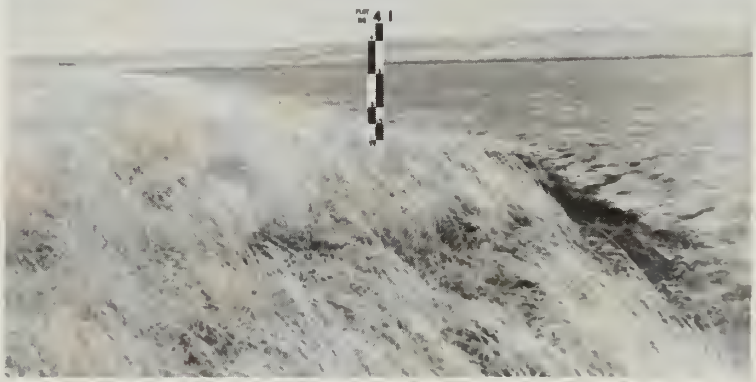
Pasture 1

Pasture 2

Figure 11. Sequential photos on this and the following page showing residual vegetation on the shore of a stock pond in Montana after various grazing treatments. See page 25 of text for grazing dates. All photos in this sequence were taken on April, 25, 1975.

Pasture 3

Pasture 4



Pasture 5

Since a higher than average number of breeding pairs of ducks will be found in the pastures with the most residual vegetation, grazing in these pastures should be deferred, when possible, until after the peak of waterfowl nesting activities. This practice would reduce nest loss by livestock trampling, particularly in those species of ducks which tend to nest close to the ponds (Gjersing 1971). Figure 12 shows the approximate hatching peaks of the major waterfowl species nesting on stock ponds in the northern plains. Although some year to year variations will occur as a result of spring weather, a July 15 livestock turn-in date would usually be after the peak of all but a couple of late nesting species.

The female segment of a waterfowl population has a tendency to "home" or return to the area on which they nested or were reared the previous year. In south Phillips County, Montana, where a stock pond density of 2 to 3 ponds per square mile provides most of the waterfowl habitat, homing by Blue-winged Teal is often to the same pond. Eng and Greene (Unpub. field notes) trapped 8 banded females with broods, 7 of which had been initally trapped and banded on the same pond in previous years.

In the dynamics of rest-rotation grazing, vegetation conditions in a given pasture can change drastically from year to year. Thus, waterfowl experiencing excellent nesting and brood rearing conditions in a pasture one year, may return the next to find conditions less than favorable. However, Mundinger (1975), through the use of marked birds, observed that returning females tend to make adjustments and move to nearby ponds with better cover conditions. He recommended that grazing formulas on adjacent management units be such that pastures favoring waterfowl production in a given year come up in a "checkerboard" fashion to reduce distances which nesting females would have to move to find improved cover conditions. Figure 13 illustrates the changes which may occur near a stock pond in a single pasture during a two-year period. This pasture was rested in 1974, grazed from May 1 to July 15 in 1975, and from June 1 to October 31 in 1976. This pasture had excellent cover for nesting ducks arriving in the early spring, 1975, fair in 1976 and very poor in 1977 (October, 1976).

Deferred Grazing

Deferred grazing is a management plan which is designed to allow for reproduction and restoration of vigor in designated range plants. A given unit of land is usually divided into pastures and certain pastures are not grazed until the "key" range plants have produced seed. Usually this grazing system is combined with rotation so all pastures periodically receive the benefits of deferred use.

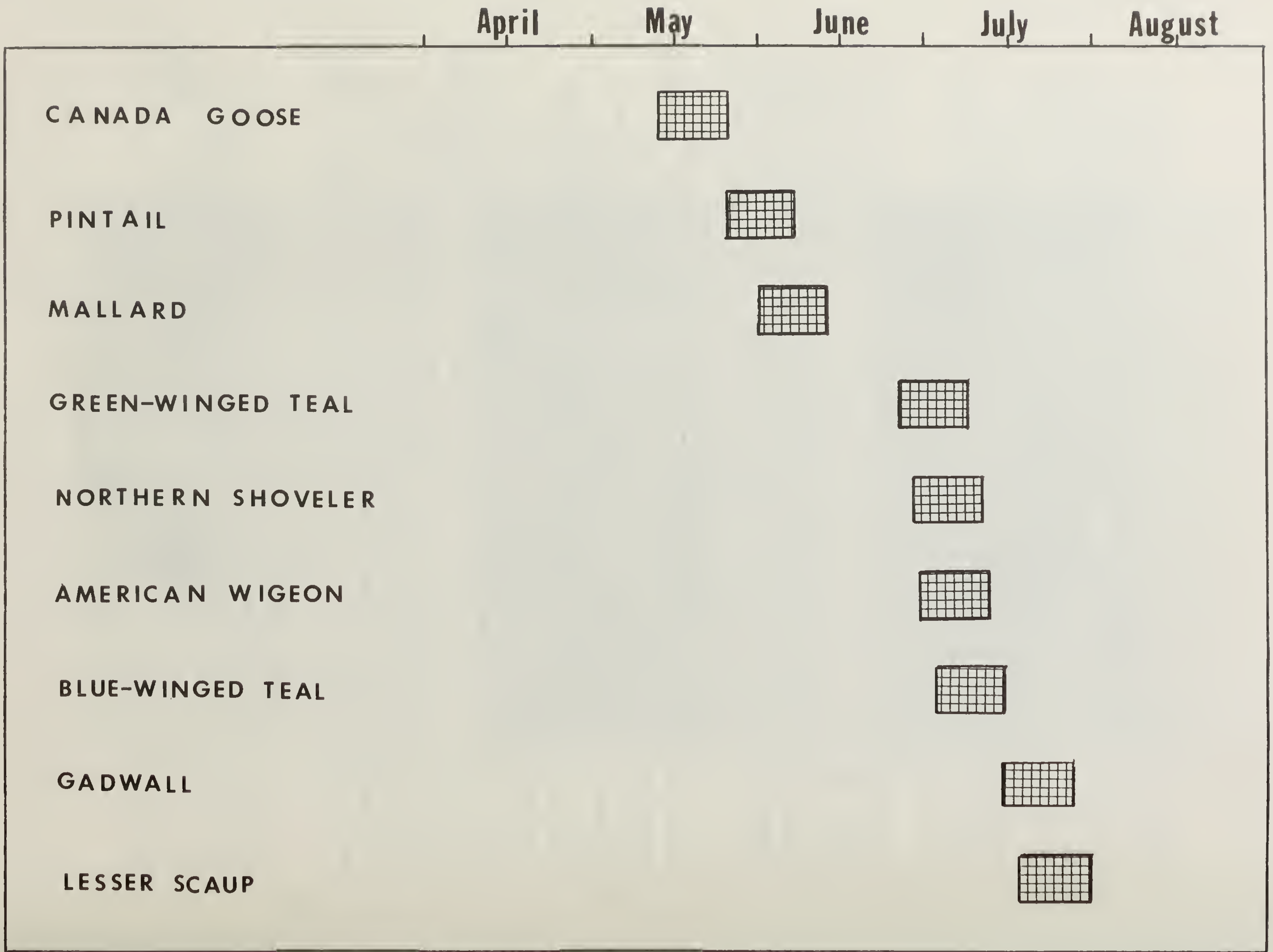


Figure 12. Seasonal sequences of peak waterfowl hatching periods.

April 25, 1975

May 30, 1975

October 31, 1975

Figure 13. These photos and those on the following page illustrate the sequential change in vegetation that occurred in a single pasture adjacent to a stock pond in Montana.

April 23,1976

July 1, 1976

October 21, 1976

No specific waterfowl studies have been conducted on deferred grazing systems but the results can be assumed from those of other studies.

A general regrowth of vegetation, resulting in herbaceous carry-over cover the following spring, may be expected after the end of the earliest grazing treatment if cattle are moved out of pastures at this time. Both Gjersing (1975) and Mundinger (1976) found increased numbers of breeding pairs and broods the years following gate closures after the grazing treatment on rest-rotation areas.

If a general increase in vegetation results from a specific deferred grazing system, waterfowl numbers can be expected to increase. Habitat improvement due to a general increase in vegetation was accompanied by an increase in both pair numbers and brood numbers on rest-rotation areas (Gjersing 1976, Mundinger 1976).

Stock Pond Fencing

In an effort to increase vegetation and waterfowl production, fencing of reservoirs has been tried on many rangelands of the United States (Berg 1956, Uhlig 1963, Bue et al. 1964). The high cost of fencing, maintenance and questionable response have brought the program to a halt in many areas.

Usually, only the upper end of a retention reservoir is fenced, and livestock are allowed to use the lower, deeper end for watering. Yearly fluctuations in water levels sometimes defeat the original purpose of the fence. Rundquist (1973) found that cattle were able to enter the enclosure at 3 of 4 ponds by going around the end of the fence during low water levels. Consequent trampling and utilization of vegetation occurred on both sides of the fence during this time. Fences extending farther into the pond to prevent livestock from going around, often are damaged by ice action.

Of those fences that permanently exclude cattle from an area a vegetational change is evident. Rundquist (1973) found 42 plant taxa along a transect within the fence at one sagebrush-grassland reservoir, while only 30 were identified outside. However, no difference in the height of upland herbaceous cover was noted. Berg (1956) found that fencing provided conditions which increased plant density, average height of important plant species, and modified species composition of riparian vegetation.

Although fencing apparently results in a vegetational change, the hoped for increase in waterfowl is questionable. Uhlig (1963) in

Minnesota, found the same waterfowl utilization on fenced as unfenced retention reservoirs. However, greater waterfowl use was recorded on fenced pits as compared to unfenced. Rundquist (1973) found that fenced reservoirs in grasslands were used about as much as the unfenced ones in that cover type. Lokemoen (1973) found little difference in shoreline vegetation height between fenced and unfenced reservoirs in the spring, but plants were considerably higher near fenced ponds in the summer. However, no difference in the pair-use or brood-use per wetland acre was observed between fenced and unfenced reservoirs. This comparison was made on ranges subjected to moderate grazing.

Even if fencing resulted in attracting greater numbers of waterfowl, Keith (1961) indicated that the fenced area may attract additional predators. This could result in reduced hatching success as compared with adjacent unfenced areas thus nullifying the intended gain.

It would appear that fencing of retention reservoirs *solely for waterfowl benefits* is a questionable investment, particularly when the pond is located where grazing practices will permit some seasonal relief to shoreline vegetation. However, *on small, isolated ponds and dugouts, where even moderate livestock densities would preclude maintaining shoreline vegetation or water clarity (and resulting aquatic vegetation), fencing may be the only solution to maintaining a desirable aquatic habitat.*

RECOMMENDATIONS

From the time the decision is reached that a stock pond should be constructed in a general area, through the management of the land surrounding the completed pond, many points should be considered in relation to the pond and its benefits to waterfowl. The following is a chronological sequence of these points of concern.

Pre-construction

The selection of the site is very critical since this will influence the type of stock pond to be constructed. Of the three more common types, retention and pit-retention are the most desirable, in that order, with pits or dug-outs receiving comparatively little waterfowl use.

Location of the dam on a given drainage is also of considerable importance. A pond of 1.5 or more surface acres, with up to 50 percent of its surface acreage in the 1 to 2 feet water depth, and an irregular shoreline, will be far more attractive than one of less than 1 acre, greater depth and few irregularities in the shoreline. Often a minor shifting of the dam site can provide the more desirable conditions.

Lastly, with respect to site selection, a cluster of ponds is more attractive to waterfowl than a series of isolated ponds. For example, if four pastures with a common corner each require a stock dam, placing the pond in each pasture somewhere near the common corner would make the complex of ponds more attractive and productive per surface acre than a comparable acreage would be if each pond were isolated.

During Construction

When the potential high water line has been established on the basis of the spillway level, all potential sites for islands should be assessed and construction on feasible sites be incorporated into the base project. To reduce costs, any "waste" materials from spillway cuts should be utilized in nearby shallow areas in constructing push-up islands. All potential sites for cut-off islands should be utilized and the cut-away materials incorporated into extending the islands on the outside tip, utilized as fill materials or shaped into a push-up island in shallow areas.

When fill materials for the dam are excavated from in front of the dam, it is desirable that slopes on this pit be no greater than 3:1, especially on the upstream side. This deep water section has the advantage of providing an escape area for broods during less-than-average water years. The more gentle slope on at least one side provides a potential for some aquatic vegetation during such periods.

If the amount of fill materials for the dam requires moving material from above the high water level, this material should be taken from a series of cuts perpendicular to the shoreline extending slightly below the water level. This would provide additional irregularities in the shoreline, increasing the potential for territorial pairs and provide small shallow bays for brood rearing.

Post-construction

Management of stock ponds after construction revolves primarily around proper grazing management of the surrounding land. "Proper" in this sense involves the maintenance of at least some residual shoreline and upland vegetation and the prevention of annual denudation of the shoreline.

Rest-rotation grazing with its flexibility in pasture numbers and implementation of formulas, shows considerable promise for waterfowl management. Based on the stated need of residual cover for nesting waterfowl, certain basic recommendations can be made.

1. When livestock are moved from a pasture in mid-summer, close gates to permit fall regrowth around stock ponds, making them more attractive to nesting waterfowl the following spring.

2. In pastures not grazed during the waterfowl nesting season, establish livestock turn-in dates to coincide with the completion of the waterfowl hatch. This is particularly important in pastures which were rested all, or the latter part of, the previous summer, since the presence of residual cover on pond shorelines would tend to attract nesting waterfowl and concentrated livestock use would result in nest trampling.

3. In areas where a series of rest-rotation management units are adjacent to one another, arrange the systems so rest pastures during a given year are in a checkerboard pattern rather than side by side. This would permit waterfowl which are homing to ponds in a dynamic grazing system to move to ungrazed pastures with a minimal adjustment.

When excessive livestock grazing around stock ponds occurs annually, fencing of part or all of the shoreline may be necessary to preserve the riparian and aquatic vegetation. However, the benefits of such an effort should be weighed carefully against the initial maintenance costs of this effort.

Many potential island sites are present on existing stock ponds. When routine maintenance of dams and spillways are scheduled, each pond to be repaired should be surveyed for island sites. Since repair work is often accomplished during low water periods, cut-off islands can often be constructed while obtaining fill for dam repair. Push-up islands may also be constructed with minimal additional cost since the equipment is already at the site.

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☆ U.S. GOVERNMENT PRINTING OFFICE: 1979-0-678-461/295